

WHAT IS CLAIMED IS:

1. A photoacoustic ozone detector comprising:
an acoustic chamber having an inlet for receiving a gas mixture containing ozone and an outlet for removing the gas mixture from the chamber;
an ultraviolet light source to generate ultraviolet light having wavelengths shorter than 400 nm, the ultraviolet light modulated at a modulation frequency substantially equal to a resonant frequency of the acoustic chamber, the ultraviolet light source positioned relative to the acoustic chamber so that the ultraviolet light passes through the gas mixture in the acoustic chamber; and
at least one microphone to detect an audio signal in the acoustic chamber having a frequency substantially equal to the modulation frequency of the ultraviolet light.
2. The photoacoustic ozone detector of claim 1 in which the ultraviolet light source is selected to have an emission spectrum with full width at half maximum greater than 1 nm.
3. The photoacoustic ozone detector of claim 1, further comprising a signal processor to generate an output indicative of a concentration of the ozone in the gas mixture based on the detected audio signal.
4. The photoacoustic ozone detector of claim 3, further comprising a photodetector to detect a level of the ultraviolet light passing through the acoustic chamber, the signal processor using the level of ultraviolet light for normalizing the output indicative of the concentration of the ozone.
5. The photoacoustic ozone detector of claim 1 in which the acoustic chamber comprises two tubes, the ultraviolet light passing through one of the tubes.

6. The photoacoustic ozone detector of claim 5 in which a microphone is attached to each tube, the ozone detector further comprising a signal processor to generate an output indicative of a concentration of the ozone in the gas mixture based on a difference in the audio signals detected by the microphones.

7. The photoacoustic ozone detector of claim 1 in which the acoustic chamber has two ends, each coupled to an acoustic filter to reduce background noise having a frequency substantially equal to the resonant frequency.

8. The photoacoustic ozone detector of claim 7 in which the acoustic filter comprises a quarter wavelength acoustic filter.

9. The photoacoustic ozone detector of claim 1 in which the ultraviolet light source comprises an electric discharge lamp.

10. The photoacoustic ozone detector of claim 9 in which the electric discharge lamp comprises xenon gas and iodine gas.

11. The photoacoustic ozone detector of claim 1 in which the ultraviolet light source generates ultraviolet light having wavelengths between 240 nm to 270 nm.

12. The photoacoustic ozone detector of claim 1 in which the acoustic chamber is selected to have dimensions so that the resonant frequency is between 100 Hz to 40 kHz.

13. An apparatus comprising:
an acoustic chamber to receive a gas mixture;
a light source having an emission spectrum having at least one emission peak with a full width at half maximum greater than 1 nm, the light source emitting light that is modulated at a frequency substantially equal to a resonant frequency of the chamber; and

a detector to detect a signal indicative of absorption of the modulated light by a gas component in the gas mixture, the signal having a frequency substantially equal to the modulation frequency of the light.

14. The apparatus of claim 13 in which the gas mixture comprises ozone (O_3), and the light source generates ultraviolet light comprising light waves having wavelengths between 240 nm to 270 nm.

15. The apparatus of claim 13 in which the gas mixture comprises sulfur dioxide (SO_2), and the light source generates light comprising light waves having wavelengths between 270 nm to 310 nm.

16. The apparatus of claim 13 in which the gas mixture comprises nitric dioxide (NO_2), and the light source generates light comprising light waves having wavelengths between 350 nm to 450 nm.

17. The apparatus of claim 13, further comprising a signal processor to generate an output indicative of a concentration of gas component in the gas mixture based on the detected signal.

18. The apparatus of claim 13 in which the light source emits ultraviolet light waves having wavelengths between 237 nm and 275 nm.

19. The apparatus of claim 13 in which the modulation frequency is substantially equal to a resonant frequency of the chamber.

20. The apparatus of claim 19 in which the acoustic chamber has a dimension so that the resonant frequency is between 100 Hz to 40 kHz.

21. The apparatus of claim 13, further comprising an acoustic filter attached to an end of the chamber to reduce background noise having a frequency substantially equal to a modulation frequency of the light emitted from the light source.

22. The apparatus of claim 13, further comprising a gas handling system to supply the gas mixture.

23. An apparatus comprising:

- a first resonator tube to receive a portion of a gas mixture;
- a second resonator tube to receive another portion of the gas mixture, the first and second resonator tubes having a common resonant frequency;
- a first microphone to generate a first output representing acoustic signals in the first resonator tube;
- a second microphone to generate a second output representing acoustic signals in the second resonator tube;
- a light source having an emission spectrum broader than 1 nm near a predetermined wavelength, the light source emitting light that is modulated at a frequency substantially equal to the resonant frequency, the light passing through the first resonator tube; and
- a signal processor to determine a difference between the first and second outputs to generate a differential output having a frequency substantially equal to the modulation frequency.

24. The apparatus of claim 23, further comprising a gas handling system to supply the gas mixture.

25. A method comprising:

detecting ozone in a gas mixture in an acoustic chamber irradiated with ultraviolet light that is modulated at a frequency that is substantially equal to a resonant frequency of the acoustic chamber, including measuring a signal representing changes in a pressure of the gas mixture, the signal having a frequency substantially equal to the modulation frequency of the ultraviolet light, the ultraviolet light having an emission spectrum with a full width at half maximum greater than 1 nm, the ultraviolet light having components with wavelengths less than 400 nm.

26. The method of claim 25 in which the modulation frequency of the ultraviolet light is between 100 Hz to 40 kHz.

27. The method of claim 25, further comprising normalizing the signal based on a detected level of ultraviolet light passing through the acoustic chamber.

28. The method of claim 27, further comprising generating an output indicative of a concentration of the ozone in the gas mixture based on an amplitude of the normalized signal.

29. The method of claim 27, further comprising generating the ultraviolet light using an electric discharge lamp.

30. The method of claim 27 in which the acoustic chamber comprises two resonator tubes, each corresponding to a microphone, the ultraviolet light passing through one of the tubes.

31. The method of claim 30 in which measuring the signal representing changes in the pressure of the gas mixture comprises determining a difference between audio signals measured by the two microphones.

32. A method comprising:
- supplying a gas mixture to a chamber, the gas mixture containing a gas component to be detected;
 - generating light waves from a light source having an emission spectrum with at least one emission peak and having a full width at half maximum greater than 1 nm;
 - modulating the light wave at a modulation frequency corresponding to a resonant frequency of the chamber;
 - passing the modulated light waves through the chamber; and
 - detecting a signal having a frequency substantially equal to the modulation frequency.
33. The method of claim 32, further comprising generating an output indicative of a concentration of the gas component based on the detected signal having a frequency substantially equal to the modulation frequency.
34. The method of claim 32 in which the gas component comprises ozone.
35. The method of claim 32 in which the light waves have components having wavelengths between 235 nm and 275 nm.
36. The method of claim 32 in which the modulation frequency is substantially equal to a resonant frequency of the chamber.
37. The method of claim 36 in which the resonant frequency of the chamber is between 100 Hz to 40 kHz.
38. The method of claim 32, further comprising detecting an intensity of the ultraviolet light after passing through the chamber, and normalizing the output indicative of the concentration of the ozone based on the intensity of the ultraviolet light.

39. The method of claim 32, further comprising filtering background noise by using acoustic quarter wave filters to increase the signal-to-noise ratio of the signal having a frequency substantially equal to the modulation frequency.

40. A method comprising:

- receiving a portion of a gas mixture at a first resonator tube;
- receiving another portion of the gas mixture at a second resonator tube, the first and second resonator tubes having a common resonant frequency;
- passing light through the first resonator tube, the light generated from a light source having an emission spectrum broader than 1 nm near a predetermined wavelength, the light being modulated at a frequency substantially equal to the resonant frequency;
- detecting a first acoustic signal in the first resonator tube;
- detecting a second acoustic signal in the second resonator tube; and
- determining a difference between the first and second acoustic signals.

41. The method of claim 40, further comprising generating an output indicative of a concentration of the gas component based on the detected signal having a frequency substantially equal to the modulation frequency.

42. The method of claim 41 in which the gas component comprises ozone.